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Interventions and Management

1. Fifteen-minute consultation: Management of the upper limb in unilateral cerebral palsy.

Cadwgan J, Pearse J, Devlin A, Basu A.

Arch Dis Child Educ Pract Ed. 2018 Jul 3. pii: edpract-2017-313794. doi: 10.1136/archdischild-2017-313794. [Epub ahead of print]

Children with unilateral cerebral palsy (UCP) have complex health, education and social care needs. Delayed gross motor milestones are the most common presenting feature, and much of the early management focuses on gross motor skills and lower limb management. In later childhood, adolescence and adulthood, upper limb function has significant impact on activity, participation and independence. There is clear pathophysiological rationale and emerging clinical evidence that earlier intervention to improve upper limb function is beneficial. Whereas most children with UCP are managed in secondary care, it is recommended that the assessment and delivery of specialist intervention for the upper limb occurs at a regional centre.

[PMID: 29970591](#)

2. The short-term effects of selective dorsal rhizotomy on gait in cerebral palsy.

O'Sullivan R, Kiernan D, McLoughlin B, Leonard J.

Gait Posture. 2018 Jun 21. pii: S0966-6362(18)30767-7. doi: 10.1016/j.gaitpost.2018.06.040. [Epub ahead of print]

[PMID: 29958782](#)

3. [Effects of intradermal needling on core muscle stability in children with cerebral palsy: a clinical comparative study]. [Article in Chinese]

Qi T, Wang C.

Zhongguo Zhen Jiu. 2018 Jun 12;38(6):597-601. doi: 10.13703/j.0255-2930.2018.06.007.

To observe the effects of rehabilitation training (RT) combined with intradermal needling, RT combined with acupuncture and RT alone on core muscle stability in children with cerebral palsy, and to explore the superior therapy to improve core muscle stability in children with cerebral palsy. A total of 120 children with cerebral palsy aged from 2 to 4 years old were randomly divided into a RT and intradermal needling group (group A), a RT and acupuncture group (group B) and a RT group (group C), 40 cases in each one. The patients in the group C were treated with kinesiotherapy and core muscle stability training, once a day. Along with identical RT of group C, the patients in the group B were treated with acupuncture (once a day), while the patients in the group A were treated with intradermal needling at Yaoyangguan (GV 3), Mingmen (GV 4), Jiaji (EX-B 2, L2-L5), and 4-week treatment was taken as one course.

The integrated electromyography (iEMG) of surface electromyography, root mean square (RMS) and mean power frequency (MPF) of erector spinae muscles, Berg balance scale as well as B area (sitting), C area (climbing and kneeling), D area (standing) and E area (walking, running and jumping) of gross motor function measure (GMFM) were compared before and after 3-course treatment. □ Compared before treatment, the iEMG and RMS of erector spinae muscles in the group A and group B as well as MPF in the group A were all increased after treatment (all $P<0.05$); after treatment, all the electromyography indexes in the group A were higher than those in the group B and group C (all $P<0.05$); the RMS in the group B was higher than that in the group C ($P<0.05$). □ Compared before treatment, the Berg balance scale was all increased after treatment in the three groups (all $P<0.05$), and the scale in the group A was higher those that in the group B and group C (both $P<0.05$). □ Compared before treatment, the B area and C area of GMFM in the three groups as well as D area in the group A and group B were all improved after treatment (all $P<0.05$); the B area, C area and D area in the group A and group B were higher than those in the group C (all $P<0.05$); the B area and C area in the group A were higher than those in the group B (both $P<0.05$). Based on RT, the intradermal needling could better improve core muscle stability and balance-motor ability in children with cerebral palsy, which is superior to regular acupuncture and RT alone.

[PMID: 29972001](#)

4. [Effects of acupuncture on muscle tension of lower limb in children with spastic cerebral palsy]. [Article in Chinese]

Zhang M, Liu Z.

Zhongguo Zhen Jiu. 2018 Jun 12;38(6):591-5. doi: 10.13703/j.0255-2930.2018.06.006.

To observe the effects of acupuncture at different acupoints in yin meridians and yang meridians on lower limb muscle tension in children with spastic cerebral palsy. Ninety children with spastic cerebral palsy aged between 2 to 6 years old were divided into a yin-meridian group, a yang-meridian group and a rehabilitation group, 30 cases in each one. The patients in the rehabilitation group were treated with routine rehabilitation treatment; the patients in the yin-meridian group were treated with routine rehabilitation treatment and acupuncture at Xuehai (SP 10), Yinlingquan (SP 9), Sanyinjiao (SP 6), Taixi (KI 3) and Taichong (LR 3) along yin meridians; the patients in the yang-meridian group were treated with routine rehabilitation treatment and acupuncture at Futu (ST 32), Zusanli (ST 36), Yanglingquan (GB 34), Guangming (GB 37) and Xuanzhong (GB 39) along yang meridians. All the three groups were treated once each other day, 10 times as one course, and totally 20-day treatment was given. Before and after treatment, modified Ashworth scale (MAS), clinical spasm index (CSI) and integrated electromyography (iEMG) of surface electromyogram of gastrocnemius muscle were evaluated. Compared before treatment, the MAS and CSI in the yin-meridian group and yang-meridian group were improved after treatment ($P<0.05$, $P<0.01$); the differences before and after treatment in the rehabilitation group were not significant (both $P>0.05$). After treatment, the differences between the rehabilitation group and yin-meridian group, yang-meridian group were significant ($P<0.05$, $P<0.01$); the differences of MAS and CSI between the yin-meridian group and yang-meridian group were not significant (both $P>0.05$). Compared before the treatment, the right-side iEMG and left-side iEMG were reduced in the yin-meridian group and yang-meridian group (all $P<0.05$); the right-side iEMG was increased in the rehabilitation group ($P<0.05$). After treatment, the iEMG in the yin-meridian group and yang-meridian group were lower than that in the rehabilitation group (all $P<0.05$); the differences of iEMG before and after treatment in the yin-meridian group and yang-meridian group were higher than that in the rehabilitation group (all $P<0.05$); the differences of iEMG between the yin-meridian group and yang-meridian group were not significant (both $P>0.05$). Acupuncture at yin meridians and yang meridians could reduce muscle tension of lower limb and improve limb spasticity in children with spastic cerebral palsy, and the two acupuncture methods have similar clinical curative effect.

[PMID: 29972000](#)

5. Is there a relationship between trunk control, hand ability, communication and eating-drinking functions in children with spastic cerebral palsy?

Seyhan K, Çankaya Ö, Günel MK.

Gait Posture. 2018 Jun 19. pii: S0966-6362(18)30789-6. doi: 10.1016/j.gaitpost.2018.06.062. [Epub ahead of print]

[PMID: 29958786](#)

6. Does one leg standing duration have relation with GMFM scores and stability in stance phase for Hemiplegic children?

Ertürk G, Akalan NE, Evrendilek H, Karaca G, Bilgili F.

Gait Posture. 2018 Jun 25. pii: S0966-6362(18)30892-0. doi: 10.1016/j.gaitpost.2018.06.135. [Epub ahead of print]

[PMID: 29960742](#)

7. [Effect of suspension exercise training on motor and balance functions in children with spastic cerebral palsy]. [Article in Chinese]

Wang J, Lang YB, DU JH, Chen Z, Zhu DN, Zhang Y, Li MY, Tong P.

Zhongguo Dang Dai Er Ke Za Zhi. 2018 Jun;20(6):465-469.

To study the effect of suspension exercise training on motor and balance functions in children with spastic cerebral palsy. A total of 97 children with spastic cerebral palsy were randomly divided into an observation group with 49 children and a control group with 48 children. Both groups were given routine rehabilitation training, and the children in the observation group were given suspension exercise training in addition. The scores of the D and E domains of the 88-item version of the Gross Motor Function Measure (GMFM-88) and Berg Balance Scale (BBS) were recorded before treatment and at 1, 3, and 6 months after treatment. Surface electromyography was performed to observe the changes in the root mean square (RMS) of surface electromyogram signals of the adductor muscle and the gastrocnemius muscle. Over the time of treatment, both groups had varying degrees of improvement in the scores of the D and E domains of GMFM-88 and BBS. Compared with the control group, the observation group had significantly greater improvements in D and E functional areas and balance function ($P < 0.05$). Both groups had reductions in the RMS of the surface electromyogram signals of the adductor muscle and the gastrocnemius muscle over the time of treatment, and the observation group had significantly greater reductions than the control group ($P < 0.05$). Suspension exercise training can effectively improve the motor and balance functions of children with spastic cerebral palsy.

[PMID: 29972120](#)

8. Dynamic spasticity determines hamstring length and knee flexion angle during gait in children with spastic cerebral palsy.

Choi JY, Park ES, Park D, Rha DW.

Gait Posture. 2018 Jun 25;64:255-259. doi: 10.1016/j.gaitpost.2018.06.163. [Epub ahead of print]

Previous researchers reported that popliteal angle did not correlate well with knee angle during gait in individuals with spastic cerebral palsy (CP). To determine if hamstring spasticity, as measured by Modified Tardieu Scale (MTS) at rest, is associated with knee flexion angle at initial contact and midstance during gait. Thirty ambulatory children (mean age 8.7 ± 2.4 years) diagnosed with spastic CP participated. The hamstrings' spasticity was assessed in the supine position with the MTS, measuring R1 (muscle reaction to passive fast stretch), R2 (passive range of motion), and R2-R1 (dynamic component of spasticity). We conducted 3-dimensional computerized gait analysis and calculated semimembranosus muscle-tendon length and lengthening velocity during gait using musculoskeletal modeling and inverse kinematic analysis by OpenSim. Pearson correlation coefficients were calculated to estimate the association of MTS with biomechanical parameters during gait. Knee flexion angle at initial contact and maximal knee extension angle during stance phase significantly positively correlated with both R1 and R2 - R1 of MTS, but not with R2 angle. The length of semimembranosus at initial contact, end of swing, and minimal length during stance phase were strongly negatively associated with R1, rather than R2 or R2 - R1 angles. The R1 angle of MTS (muscle reaction to passive fast stretch) is more relevant correlate of knee flexion angle during gait than the R2 (passive range of motion).

[PMID: 29960141](#)

9. Health professionals' experiences and barriers encountered when implementing hip surveillance for children with cerebral palsy.

Willoughby KL, Toovey R, Hodgson JM, Graham HK, Reddihough DS.

J Paediatr Child Health. 2018 Jul 5. doi: 10.1111/jpc.14108. [Epub ahead of print]

This study aimed to explore health professionals' experiences of implementing hip surveillance for young people with cerebral palsy (CP) and to identify any barriers they encounter. A cross-sectional web-based survey of health professionals supporting children with CP was conducted. Responses were analysed through mixed methods. Responses to items presented as ordinal scales were analysed using descriptive statistics, and open-ended responses through a qualitative approach to identify themes. A total of 32 paediatricians, 2 rehabilitation specialists and 50 physiotherapists completed the survey, with respondents working within both hospital- and community-based settings. Barriers most frequently reported were inconsistency in radiology practice and reporting (35%), parent engagement (32%), limited communication between clinicians (31%), lack of clarity in lines of responsibility (27%) and forgetting to undertake surveillance (26%).

Four major themes were identified through qualitative analysis: (i) recognition of the importance of clinical guidelines to hip surveillance; (ii) the value of each role in the team around a child; (iii) the challenge of sharing responsibility; and (iv) the importance of communication in facilitating collaboration. Barriers can be encountered at each phase of the hip surveillance process, but there are also factors that act as facilitators. Locally, the results will inform the development of an enhanced state-wide approach to hip surveillance for all children with CP. The identified barriers do not appear unique to the local context, and the findings may be transferable to other settings. Awareness of the potential barriers and facilitators would be valuable to those implementing hip surveillance in other areas.

[PMID: 29975007](#)

10. Kinematic and strength determinants of step length and step frequency in children and adolescents with cerebral palsy.

Pouliot-Laforte A, Parent A, Lemay M, Ballaz L.

Gait Posture. 2018 Jun 21. pii: S0966-6362(18)30770-7. doi: 10.1016/j.gaitpost.2018.06.043. [Epub ahead of print]

[PMID: 29970279](#)

11. The natural history of crouch gait in bilateral cerebral palsy: A systematic review.

O'Sullivan R, Horgan F, O'Brien T, French H.

Res Dev Disabil. 2018 Jun 26;80:84-92. doi: 10.1016/j.ridd.2018.06.013. [Epub ahead of print]

To systematically review the natural history of crouch gait in bilateral cerebral palsy (CP) in the absence of surgical intervention and to review any relationship between clinical variables and progression of knee crouch. Relevant literature was identified by searching article databases (PubMed, CINAHL, EMBASE, and Web of Science). Included studies reported on participants with bilateral CP who had 3-dimensional gait analysis on at least two occasions with no surgical interventions between analyses. Five papers (4 retrospective cohort studies; 1 case report) comprised the final selection. Studies varied in follow-up times and participant numbers. Increased knee flexion over time was reported in the four retrospective studies with two distinct patterns of increasing knee flexion evident. Only the case-study reported improved knee extension between assessments. Four studies demonstrated increased hamstring tightness over time with the biggest increases related to longer follow-up time rather than increase in crouch. The existing literature suggests that the natural history of crouch gait is towards increasing knee flexion over time. Future prospective studies of bigger groups are needed to examine the relationship between increasing crouch and clinical variables.

[PMID: 29960128](#)

12. Botulinum toxin: Techniques within pediatric physiatry.

Paulson A, Zigler CK, Houtrow A, Pruitt D.

PM R. 2018 Jun 29. pii: S1934-1482(18)30353-8. doi: 10.1016/j.pmrj.2018.06.004. [Epub ahead of print]

Intramuscular botulinum toxin injections are utilized for treatment of focal spasticity in children, particularly in those with a diagnosis of cerebral palsy. There are a variety of techniques used when performing botulinum toxin injections without clear standards for pediatric providers. To describe current practice techniques for botulinum toxin injections among pediatric physiatrists. Cross sectional survey using RedCap Software. Pediatric physiatrists who perform botulinum toxin injections. Survey of 307 pediatric physiatrists. Analysis of data from the 2017 practice survey of pediatric physiatrists in the United States. Physicians were asked the primary botulinum toxin used, common dosing information, the role of localization, and the role of sedation and distraction in their practice. Nearly all pediatric physiatrists utilize OnabotulinumtoxinA as the primary formulation of botulinum toxin. The maximum dose per body weight used per injection series had a median of 15 units/kilogram and a median maximum total dose of 500 units. Sixty-five percent of pediatric physiatrists report using sedation, of any type, for botulinum toxin injections. When using sedation, the most common primary method was general anesthesia (38.9%), followed by enteral or nasal anxiolytic with the patient awake (26.2%). The most common reported intended injection site for botulinum toxin was "in multiple sites spread throughout the muscle" (67.9%) then "one site of the muscle at the motor point" (17.1%). Large muscles were injected using primarily anatomic guidance (75.6%) and electromyography (50.8%), and small muscles were primarily completed with electromyography (73.6%) and anatomic guidance (49.2%). There is considerable variability present in one common procedure performed by pediatric physiatrists.

[PMID: 29964211](#)

13. Decoding Inner Speech Using Electrocardiography: Progress and Challenges Toward a Speech Prosthesis.

Martin S, Iturrate I, Millán JDR, Knight RT, Pasley BN.

Front Neurosci. 2018 Jun 21;12:422. doi: 10.3389/fnins.2018.00422. eCollection 2018.

Certain brain disorders resulting from brainstem infarcts, traumatic brain injury, cerebral palsy, stroke, and amyotrophic lateral sclerosis, limit verbal communication despite the patient being fully aware. People that cannot communicate due to neurological disorders would benefit from a system that can infer internal speech directly from brain signals. In this review article, we describe the state of the art in decoding inner speech, ranging from early acoustic sound features, to higher order speech units. We focused on intracranial recordings, as this technique allows monitoring brain activity with high spatial, temporal, and spectral resolution, and therefore is a good candidate to investigate inner speech. Despite intense efforts, investigating how the human cortex encodes inner speech remains an elusive challenge, due to the lack of behavioral and observable measures. We emphasize various challenges commonly encountered when investigating inner speech decoding, and propose potential solutions in order to get closer to a natural speech assistive device.

[PMID: 29977189](#)

14. Oropharyngeal dysphagia in adults with dyskinetic cerebral palsy and cervical dystonia: a preliminary study.

Seo HG, Yi YG, Choi YA, Leigh JH, Yi Y, Kim K, Bang MS.

Arch Phys Med Rehabil. 2018 Jun 26. pii: S0003-9993(18)30383-6. doi: 10.1016/j.apmr.2018.05.024. [Epub ahead of print]

To investigate the characteristics of oropharyngeal dysphagia in adults with dyskinetic cerebral palsy (DCP) and cervical dystonia (CD). Exploratory observational cross-sectional study. University hospital. Seventeen patients with DCP (8 males, 9 females; age, 45.7±6.3 years) enrolled in a randomized controlled trial on the effects of botulinum toxin injection on CD. Baseline clinical assessments and videofluoroscopic swallowing studies (VFSSs) were conducted. VFSS findings were evaluated using the videofluoroscopic dysphagia scale (VDS) and the penetration-aspiration scale (PAS). The Gross Motor Function Classification System (GMFCS) and Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) scores were also assessed. Relationships between outcomes were evaluated using Spearman's rank correlation. The clinical assessment revealed abnormalities in chewing (10/17, 58.8%), tongue movement (10/17, 58.8%), and laryngeal elevation (8/17, 47.1%). The most common abnormality on the VDS was inadequate mastication (13/17, 76.5%), followed by premature bolus loss, vallecular residue, and penetration/aspiration (all: 10/17, 58.8%). A maximum PAS score of 8 was observed in 8/17 patients (47.1%). Total and pharyngeal VDS scores were significantly correlated with TWSTRS scores ($\rho=0.543$, $p=0.024$ and $\rho=0.539$, $p=0.026$, respectively); the VDS oral score did not correlate with the TWSTRS score ($\rho=0.446$, $p=0.073$). There was no significant correlation between VDS score and GMFCS level ($\rho=0.212$, $p=0.414$). This preliminary observational study presents the characteristics of oropharyngeal dysphagia in adults with DCP and CD. Pharyngeal stage difficulties were negatively correlated with severity of CD, but not with GMFCS level. Screening for dysphagia may be recommended in adults with DCP and severe CD.

[PMID: 29958905](#)

15. Validity and reliability of the mixing ability test as masticatory performance outcome in children with spastic cerebral palsy and children with typical development: a pilot study.

Remijn L, Vermaire JA, Nijhuis-van de Sanden MWG, Groen BE, Speksnijder CM.

J Oral Rehabil. 2018 Jul 4. doi: 10.1111/joor.12690. [Epub ahead of print]

The mixing ability test (MAT) as an outcome of masticatory performance is largely used in studies with adults, but not yet with children. This study aimed to test the construct validity and the test-retest reliability of the MAT in children with spastic cerebral palsy (CP) and children with typical development (TD). The results of the MAT were correlated with tongue movements, mandible movements, relative muscle contraction, and clinical observation measured with ultrasound, 3D kinematics, electromyography (EMG), and relevant items of the Mastication Observation and Evaluation (MOE) instrument, respectively. Moreover, the between groups effect was tested. Test-retest reliability was calculated with an intraclass correlation coefficient (ICC) and standard error of measurement (SEM). Twenty-one children (7 children with spastic CP and 14 children with TD) participated in this study. The MAT scores showed moderate to good correlations with some variables of the tongue movements, horizontal mandible movements and occlusion duration, relative muscle contraction of the left temporalis, and all six MOE items ($-0.80 < r < 0.49$). The MAT scores were significantly higher for children with CP (mean 22.6; SD 2.4) compared to children with TD (mean 19.9; SD 1.9). The test-retest reliability had an ICC of 0.7 and a SEM of 1.16 ($\pm 5\%$ of the mean score). These results indicate that the MAT is suitable and complementary to ultrasound, 3D kinematics, EMG, and observation to compare the masticatory performance between children with CP and children with TD, with an acceptable test-retest reliability. This article is protected by copyright. All rights reserved.

[PMID: 29972243](#)

16. Protocol for N-of-1 trials proof of concept for rehabilitation of childhood-onset dystonia: Study 1: Protocole des essais de validation à effectif unique pour la réadaptation de la dystonie débutant dans l'enfance : Étude 1.

Gimeno H, Polatajko HJ, Cornelius V, Lin JP, Brown RG.

Can J Occup Ther. 2018 Jun;85(3):242-254. doi: 10.1177/0008417417707532.

Hyperkinetic movement disorders (HMD) are a heterogeneous group of neurological conditions among which dystonia is the predominant disorder and dyskinetic cerebral palsy the largest secondary dystonia group. Currently, there are no evidence-based, non-medical management options for childhood HMD. The Cognitive Orientation to daily Occupational Performance (CO-OP) Approach is a task-oriented, performance-based intervention that focuses on participation. This paper reports the protocol for a proof-of-concept study to assess feasibility and preliminary evidence regarding efficacy of CO-OP for HMD following deep brain stimulation (DBS). A series of N-of-1 trials with replications will be conducted with children, ages 6 and 21 years with HMD and DBS as indicated by the Manual Ability Classification System. Ten individualized CO-OP sessions, with multiple baselines before, during, and after, will be completed. The primary outcome measures are the Performance Quality Rating Scale and the Assessment of Motor and Process Skills. Outcome data will be plotted over time for each participant and supplemented with graph statistical analysis and effect size estimates. A written protocol will be developed based on evidence and feedback incorporating any changes to the CO-OP intervention for children and young people with HMD, as per the Medical Research Council's Framework for Complex Interventions.

[PMID: 29972044](#)

17. Protocol for N-of-1 trials with replications across therapists for childhood-onset dystonia rehabilitation: Study 2: Protocole des essais à effectif unique avec répétitions par différents ergothérapeutes pour la réadaptation de la dystonie débutant dans l'enfance : Étude 2.

Gimeno H, Polatajko HJ, Cornelius V, Lin JP, Brown RG.

Can J Occup Ther. 2018 Jun;85(3):255-260. doi: 10.1177/0008417417707734.

Currently, no evidence-based rehabilitation interventions are available for hyperkinetic movement disorders (HMD), including dyskinetic cerebral palsy (CP). Among these highly heterogeneous disorders, dystonia is the predominant disorder. The Cognitive Orientation to daily Occupational Performance (CO-OP) Approach -a task-oriented, performance-based intervention to enable participation - is currently being evaluated for its potential as an intervention option. This paper reports the protocol for the second of two studies designed to evaluate the potential of CO-OP to improve functional outcomes for individuals with HMD following deep brain stimulation (DBS). This second study is a systematic replication across multiple treating therapists from multiple centres. Systematic replications will be used across centres and treating therapists trained in the CO-OP, using a series of randomized multiple-baseline N-of-1 trials. Participants will be ages 6 to 21 years with HMD and DBS as indicated by the Manual Ability Classification System. Data collection will involve multiple data points collected at baseline, during intervention, and after intervention. The intervention will involve occupation-based goal setting followed by 10 individualized CO-OP sessions. The primary outcome measures are the Performance Quality Rating Scale and the Canadian Occupational Performance Measure. Outcome data will be plotted over time for each participant and supplemented with graph statistical analysis and estimate size effect for N-of-1 trials. The results of this study will help to inform future training procedures and future clinical trials.

[PMID: 29972046](#)

18. Physical growth, neurodevelopment and cognition outcomes in children with abdominal wall defects: a tale with two endings?

Walker K, Holland AJA.

Arch Dis Child Fetal Neonatal Ed. 2018 Jul 2. pii: fetalneonatal-2018-315099. doi: 10.1136/archdischild-2018-315099. [Epub ahead of print]

[PMID: 29967184](#)

19. Prevalence of sleep problems and sleep-related characteristics in preschool- and school-aged children with cerebral palsy.

Horwood L, Mok E, Li P, Oskoui M, Shevell M, Constantin E.

Sleep Med. 2018 May 24;50:1-6. doi: 10.1016/j.sleep.2018.05.008. [Epub ahead of print]

To determine, in preschool- and school-aged children with cerebral palsy (CP): (i) the prevalence of sleep disorders, including disorders of initiation and maintenance of sleep, and (ii) the association between child characteristics and sleep disorders. Children with CP aged 3-12 years were recruited from neurology clinics and a provincial CP registry. Caregivers completed the Sleep Disturbance Scale for Children (SDSC) and a questionnaire on sleep-related characteristics. Children's medical information was collected from the registry and hospital records. 150 children with CP (mean age \pm standard deviation: 6.9 ± 2.9 years) completed the study (66 preschool- and 84 school-aged children). An abnormal total score on the SDSC was found in 20.7% of children (10.6% and 28.6% of preschool- and school-aged children, respectively). Overall, 44.0% of children had one or more sleep disorder (24.2% and 59.5% in preschool- and school-aged children, respectively), as determined by subscales of the SDSC. The most common sleep problem, disorders of initiation and maintenance of sleep, was found in 26.0% of children (18.2% of preschool- and 32.1% of school-aged children, respectively). Pain was the strongest predictor of having an abnormal total score and disorders of initiation and maintenance of sleep, with odds ratios (95% confidence intervals) of 6.5 (2.2-18.9) and 3.4 (1.3-9.3), respectively, adjusted for age group and degree of motor impairment. Sleep disorders are prevalent in children with CP, with higher frequencies in school-aged as compared to preschool-aged children. Health care professionals caring for this population should routinely inquire about sleep problems and pain.

[PMID: 29966807](#)

20. Needs for Medical and Rehabilitation Services in Adults With Cerebral Palsy in Korea.

Park MW, Kim WS, Bang MS, Lim JY, Shin HI, Leigh JH, Kim K, Kwon BS, Jang SN, Jung SH.

Ann Rehabil Med. 2018 Jun 27;42(3):465-472. doi: 10.5535/arm.2018.42.3.465.

To investigate medical comorbidities and needs for medical and rehabilitation services of adults with cerebral palsy (CP) in Korea. This was a prospective cross-sectional study. One hundred fifty-four adults with CP were enrolled in the study between February 2014 and December 2014. Information was obtained from participants regarding functional status, demographic and socioeconomic data, medical problems, and requirements for and utilization of medical and rehabilitation services. The participants included 93 males and 61 females with a mean age of 40.18 ± 9.15 years. The medical check-up rate of adults with CP was lower than that of healthy adults and the total population with disabilities (53.2% vs. 58.6% vs. 70.4%). A quarter of the subjects failed to visit the hospital during the past year, and the main reason was the financial burden. Due to a cost burden and lack of knowledge, more than one-third of the subjects had unmet needs for rehabilitation services; the majority reported needs for rehabilitation services, such as physical therapy for pain management. The medical check-up rate was lower in the adults with CP, even though their medical comorbidities were not less than those of healthy people. Several non-medical reasons hindered them from receiving proper medical and rehabilitation services. Such barriers should be managed effectively.

[PMID: 29961745](#)

Prevention and Cure

21. Improvement by Human Oligodendrocyte Progenitor Cells of Neurobehavioral Disorders in an Experimental Model of Neonatal Periventricular Leukomalacia.

Kim TK, Park D, Ban YH, Cha Y, An ES, Choi J, Choi EK, Kim YB.

Cell Transplant. 2018 Jan 1;963689718781330. doi: 10.1177/0963689718781330. [Epub ahead of print]

The effects of human oligodendrocyte progenitor (F3. olig2) cells on improving neurobehavioral deficits were investigated in an experimental model of periventricular leukomalacia (PVL). Seven-day-old male rats were subjected to hypoxia-ischemia-lipopolysaccharide injection (HIL), and intracerebroventricularly transplanted with F3. olig2 (4×10^5 cells/rat) once at post-natal day (PND) 10 or repeatedly at PND10, 17, 27, and 37. Neurobehavioral disorders were evaluated at PND14, 20, 30, and 40 via cylinder test, locomotor activity, and rotarod performance, and cognitive function was evaluated at PND41-45 through passive avoidance and Morris water-maze performances. F3. olig2 cells recovered the rate of use of the forelimb contralateral to the injured brain, improved locomotor activity, and restored rotarod performance of PVL animals; in addition, marked improvement of learning and memory function was seen. It was confirmed that transplanted F3- olig2 cells migrated to injured areas, matured to oligodendrocytes expressing myelin basic protein (MBP), and markedly attenuated the loss of host MBP in the corpus callosum. The results indicate that the transplanted F3. olig2 cells restored neurobehavioral functions by preventing axonal demyelination, and that human oligodendrocyte progenitor cells could be a candidate for cell therapy of perinatal hypoxic-ischemic and infectious brain injuries including PVL and cerebral palsy.

[PMID: 29978719](#)

22. Incidence of Cerebral Palsy in Korea and the Effect of Socioeconomic Status: A Population-Based Nationwide Study.

Kim SW, Jeon HR, Shin JC, Youk T, Kim J.

Yonsei Med J. 2018 Aug;59(6):781-786. doi: 10.3349/ymj.2018.59.6.781.

Cerebral palsy (CP) is a neurodevelopmental disorder that causes serious disability. Prematurity and low birth weight (LBW) are known to be the strongest risk factors of CP. While socioeconomic status (SES) has been found to influence the occurrence of CP, prematurity, and LBW, no studies have investigated this effect in Korea. The aim of this study was to evaluate the incidence of CP, prematurity, and LBW in Korea, as well as the effect of SES thereon. Data were obtained from the National Health Information Database from 2007 to 2013; persons with a history of CP, prematurity, and LBW were investigated by year. SES was defined in accordance with income quintiles, birth regions, and coverage classification. The incidence of CP decreased over the last five years, despite increased rates of prematurity and LBW. CP incidence was significantly lower in affluent groups than in the most deprived group, although this difference disappeared after controlling for confounders. The incidence of CP was significantly higher in medical aid beneficiaries, even after controlling for confounders. CP incidence in Korea has decreased over the last five years, despite an increase in high-risk deliveries. Income level had no effect in CP incidence. These results may aid CP management and prevention policies.

[PMID: 29978615](#)

23. Complications with vacuum delivery from a forceps-delivery perspective: Progress toward safe vacuum delivery. Seki H.

J Obstet Gynaecol Res. 2018 Jul 5. doi: 10.1111/jog.13685. [Epub ahead of print]

To examine the rates of medical malpractice and cerebral palsy after vacuum delivery in comparison with forceps delivery and establish approaches for enabling safe vacuum delivery from the perspective of forceps delivery. This study reviewed the Japan Obstetric Compensation System report data, which contains data from studies involving 188 cases through May 2013, including cases of emergency delivery. These cases included 118 cases of cesarean section (62.8%) and 70 cases of vaginal delivery (37.2%). Of the 188 patients, 145 required emergency delivery (77.1%), of which cesarean sections were performed in 117 patients (80.7%), vacuum delivery in 24 patients (16.6%) and forceps delivery in 4 patients (2.8%). In evaluating the contents of the report with a focus on vacuum delivery, it was found that vacuum delivery was attempted in 35 patients, and delivery was successful in 24 of these patients (68.6%); however, in 11 patients (31.4%), delivery was unsuccessful and cesarean section was required. Thus, vacuum delivery was unsuccessful in approximately one third of the cases. For delivery to be completed as successfully and quickly as possible, it is essential for obstetricians to have a good understanding of the process of vacuum delivery, and to have expertise in the relevant techniques. However, it is also necessary to modify the indications under which vacuum delivery is considered safe to perform, from fetal station ± 0 , that is, engagement of the fetal head, to station +2, or descent of the fetal head.

[PMID: 29974574](#)

24. Mild Intrauterine Hypoperfusion Leads to Lumbar and Cortical Hyperexcitability, Spasticity, and Muscle Dysfunctions in Rats: Implications for Prematurity.

Coq JO, Delcour M, Ogawa Y, Peyronnet J, Castets F, Turle-Lorenzo N, Montel V, Bodineau L, Cardot P, Brocard C, Liabeuf S, Bastide B, Canu MH, Tsuji M, Cayetanot F.

Front Neurol. 2018 Jun 15;9:423. doi: 10.3389/fneur.2018.00423. eCollection 2018.

Intrauterine ischemia-hypoxia is detrimental to the developing brain and leads to white matter injury (WMI), encephalopathy of prematurity (EP), and often to cerebral palsy (CP), but the related pathophysiological mechanisms remain unclear. In prior studies, we used mild intrauterine hypoperfusion (MIUH) in rats to successfully reproduce the diversity of clinical signs of EP, and some CP symptoms. Briefly, MIUH led to inflammatory processes, diffuse gray and WMI, minor locomotor deficits, musculoskeletal pathologies, neuroanatomical and functional disorganization of the primary somatosensory and motor cortices, delayed sensorimotor reflexes, spontaneous hyperactivity, deficits in sensory information processing, memory and learning impairments. In the present study, we investigated the early and long-lasting mechanisms of pathophysiology that may be responsible for the various symptoms induced by MIUH. We found early hyperreflexia, spasticity and reduced expression of KCC2 (a chloride cotransporter that regulates chloride homeostasis and cell excitability). Adult MIUH rats exhibited changes in muscle contractile properties and phenotype, enduring hyperreflexia and spasticity, as well as hyperexcitability in the sensorimotor cortex. Taken together, these results show that reduced expression of KCC2, lumbar hyperreflexia, spasticity, altered properties of the soleus muscle, as well as cortical hyperexcitability may likely interplay into a self-perpetuating cycle, leading to the emergence, and persistence of neurodevelopmental disorders (NDD) in EP and CP, such as sensorimotor impairments, and probably hyperactivity, attention, and learning disorders.

[PMID: 29973904](#)

25. [Study of acupuncture combined with rat nerve growth factor on neurobehavioral ability of cerebral palsy infant rats and its brain tissue growth and metabolism associated proteins].[Article in Chinese]

Zhao P, Li E.

Zhongguo Zhen Jiu. 2018 Jun 12;38(6):631-6. doi: 10.13703/j.0255-2930.2018.06.018.

To study the effects of acupuncture combined with rat nerve growth factor (NGF) on the cerebral palsy infant rats and the proteins which associated with growth, apoptosis and metabolism. Seventy infant rats were selected, Fifty infant rats of which were made the cerebral palsy infant model by the ligation of unilateral carotid artery for cerebral ischemia and oxygen-deficient environment, then the 30 model rats were randomly divided into a model group, a NGF group and a combined group, 10 rats in each group. Twenty infant rats were used in the sham-operated group and the blank control group, 10 rats in each group. The treatment was not given in the blank control group. The rats in the sham-operated group were cut the neck skin and separated the left carotid artery, and then sutured and disinfected the wound. The intraperitoneal injection of NGF (2000 U•kg-1•d-1) was used in the NGF group. Based on the injection in the NGF group, acupuncture was used in the combined group, once a day, and the acupoints were "Baihui" (GV 20), left "nie I " (extra), "Dazhui" (GV 14), "Jizhong" (extra), "Quchi" (LI 11), "Yongquan" (KI 1), "Hegu" (LI 4), "Zhoujie" (extra) and "Xiqianxue" (extra). The same volume of saline was intraperitoneally injected in the model group for continuous 14 days. Neurobehavioral ability score was evaluated after treatment. TUNEL were conducted to detect the brain cell apoptosis rate and the expressions of apoptosis associated gene Bax, Bcl-2 and Casp3 were detected by PCR. The level of nerve growth associated protein (GAP-43) and energy metabolism-related protein monocarboxylate transporter protein 1 (MCT 1) were detected by Western blot. After intervention, the neurobehavioral ability of baby rats in the blank control and sham-operated group was normal, but there was various degrees of abnormality in the model group, NGF group and combined group. The scores of neurobehavioral ability of the combined group and NGF group were better than those of the model control (all $P < 0.05$), and the scores in the combined group was better than those in the NGF group (all $P < 0.05$). The left brain cell apoptosis rate, expressions of Bax and Casp3 in the combined group and NGF group were lower and the expressions of Bcl-2 were higher than those of the model group (all $P < 0.05$), with more obvious results of Bax and Casp3 in the combined group than those in the NGF group (all $P < 0.05$). The protein levels of GAP-43 and MCT 1 in the combined group and NGF group were higher than those in the model group (all $P < 0.05$), with higher expressions in the combined group compared with those in the NGF group (both $P < 0.05$). Acupuncture combined with NGF could improve the neurobehavioral ability of cerebral palsy infant rats, inhibit the nerve cell apoptosis and improve the brain tissue injury and energy metabolism by up-regulating the expressions of GAP-43 and MCT 1.

[PMID: 29972006](#)

26. Brain cooling reduces the risk of post-neonatal epilepsy in newborns affected by moderate to severe hypoxic-ischemic encephalopathy.

Lugli L, Balestri E, Berardi A, Guidotti I, Cavalleri F, Todeschini A, Pugliese M, Muttini Della Casa E, Lucaccioni L, Ferrari F.

Minerva Pediatr. 2018 Jul 2. doi: 10.23736/S0026-4946.18.05224-6. [Epub ahead of print]

Neonatal hypoxic-ischemic encephalopathy is still a significant cause of neonatal death and neurodevelopmental disabilities, such as cerebral palsy, mental delay, and epilepsy. After the introduction of therapeutic hypothermia, the prognosis of hypoxic-ischemic encephalopathy has improved, with reduction of death and disabilities. However, few studies evaluated whether hypothermia affects rate and severity of post-neonatal epilepsy. We evaluated rates, characteristics and prognostic markers of post-neonatal epilepsy in infants with moderate to severe hypoxic-ischemic encephalopathy treated or not with therapeutic hypothermia. We analyzed clinical data, EEG recordings, cerebral Magnetic Resonance Imaging (MRI) and outcome in 23 cooled and 26 non-cooled asphyxiated neonates (≥ 36 weeks' gestation), admitted from 2004 to 2012. Among 49 neonates 11 (22%) had post-neonatal epilepsy, of which 9 (18%) were non-cooled and 2 (4%) were cooled ($p = 0.05$). Six of 11 infants (55%) had West syndrome, 4 (36%) had focal epilepsy and 1 (9%) had Lennox-Gastaut syndrome. At multiple logistic regression analysis MRI pattern significantly correlated with post-neonatal epilepsy (OR 0.19, 95% CI 0.04-0.88, $p = 0.03$). Extensive lesions in basal ganglia and thalami plus cortical and white matter were associated with post-neonatal epilepsy. Only perinatal asphyxia with extensive lesions in basal ganglia and thalami plus cortical and white matter lesion conveys an high risk for early and severe post-neonatal epilepsy. Moreover therapeutic hypothermia is associated with a decrease of the risk of developing post-neonatal epilepsy.

[PMID: 29968450](#)

27. The p38 α MAPK deletion in oligodendroglia does not attenuate myelination defects in a mouse model of periventricular leukomalacia.

Chung SH, Biswas S, Sohn J, Jiang P, Dehghan S, Marzban H, Deng W.

Neuroscience. 2018 Jun 29. pii: S0306-4522(18)30455-X. doi: 10.1016/j.neuroscience.2018.06.037. [Epub ahead of print]

Periventricular leukomalacia (PVL) is a severe type of white matter damage in premature infants and the most common cause of cerebral palsy. It is generally known to be caused by hypoxia and inflammation.

Currently there is no effective treatment available, in part due to that the pathogenesis of the disease has not been well understood. The p38 α mitogen-activated protein kinase (MAPK) is the serine/threonine kinase and several in vitro studies demonstrated that p38 MAPK is essential for oligodendroglial differentiation and myelination. Indeed, our nerve/glia antigen 2 (NG2)-specific oligodendroglial p38 α MAPK conditional knockout (CKO) mice revealed its complex roles in myelination and remyelination. To identify the specific in vivo roles of oligodendroglial p38 α MAPK in PVL, we generated a mouse PVL model by combination of LPS-mediated inflammation and hypoxia-ischemia in NG2-p38 α MAPK CKO mice. Our results demonstrate that a selective deletion of p38 α MAPK in oligodendrocyte did not attenuate myelination defects in the mouse model of PVL. Myelination phenotype revealed by MBP immunostaining was not significantly affected in the p38 α MAPK CKO mice compared to the wildtype after PVL induction. The electron microscopic images demonstrated that the microstructure of myelin structures was not significantly different between the wild type and p38 α MAPK CKO mice. In addition, oligodendrocyte degeneration in the corpus callosum white matter area was unaffected in the p38 α MAPK CKO during and after the PVL induction. These data indicate that p38 α MAPK in oligodendrocyte has minimal effect on myelination and oligodendrocyte survival in the mouse PVL model.

[PMID: 29966722](#)

28. Perinatal asphyxia in a rural Nigerian hospital: Incidence and determinants of early outcome.

Egharevba OI, Kayode-Adedeji BO, Alikah SO.

J Neonatal Perinatal Med. 2018 Jun 23. doi: 10.3233/NPM-1759. [Epub ahead of print]

Perinatal asphyxia is an important cause of morbidity and mortality in the neonatal period, accounting for 20-30% of neonatal mortality. A substantial proportion (estimated at 26%) of the 1 million annual intrapartum stillbirths result from asphyxia. Probably higher than the mortality is the plethora of morbidity associated with asphyxia, especially long term neuro-developmental problems including cerebral palsy. The real burden of perinatal asphyxia is difficult to establish because of paucity of information from the rural communities where the majority of neonatal morbidity and deaths occur. Extended Apgar scores and HIE grade have been identified as predictive tools in prognosticating asphyxia, however HIE staging require a certain level of medical expertise which is not widely available. To determine the incidence of asphyxia, the mortality rate and factors associated with mortality in Irrua Specialist Hospital. It was a descriptive, retrospective study of neonates admitted into the special care baby unit (SCBU) between October 2013 and September 2014 with diagnosis of perinatal asphyxia. Data was obtained from babies' and mother's case notes. The outcome was classified as survived or died. Perinatal asphyxia accounted for 45 out of 347 (13%) of admissions within the review period. The mean gestational age and birth weight of the subjects were 39.2 \pm 2.2 weeks and 3020 \pm 520 grams respectively. The mortality rate was 31.1% and the factors significantly associated with mortality include lack of antenatal care and HIE stage III. The burden of perinatal asphyxia in Irrua Specialist Hospital is comparable to figures from similar settings in the developing world. Lack of antenatal care and HIE stage III are associated with mortality. Continuous efforts should be made to improve the uptake of antenatal care and high risk pregnancies should be delivered in centres with facilities for neonatal care.

[PMID: 29966208](#)

29. Mitophagy is activated in brain damage induced by cerebral ischemia and reperfusion via the PINK1/Parkin/p62 signalling pathway.

Lan R, Wu JT, Wu T, Ma YZ, Wang BQ, Zheng HZ, Li YN, Wang Y, Gu CQ, Zhang Y.

Brain Res Bull. 2018 Jun 28. pii: S0361-9230(18)30142-4. doi: 10.1016/j.brainresbull.2018.06.018. [Epub ahead of print]

This study examined the course of mitophagy following cerebral ischemia with reperfusion and the role of the PTEN-induced kinase 1 (PINK1)/Parkin/p62 signalling pathway. The middle cerebral artery of male Sprague-Dawley rats was occluded for 90 min and was followed by different time-points of reperfusion. Cerebral infarct areas were detected by 2,3,5-triphenyl tetrazolium chloride staining, while brain damage was observed by haematoxylin and eosin staining. Levels of LC3, Beclin1 and LAMP-1 were estimated by western blots. LC3B location was observed in various cells in the neurovascular unit. In addition, PINK1 accumulation in damaged mitochondria and Parkin/p62 mitochondrial translocation were investigated by double immunofluorescence staining. Finally, the levels of PINK1, Parkin and p62 expression in mitochondrial fractions were estimated by western blots. Cerebral ischemia with different time-points of reperfusion resulted in infarct in the territory of the middle cerebral artery accompanied by overall brain damage.

In addition, we found up-regulation of LC3B, Beclin1, and LAMP-1, as well as mitophagy activation after reperfusion, with peak expression of these proteins at 24 h after reperfusion. Electron microscopy and immunofluorescence indicated that LC3B was primarily located in neurons, although lower levels of expression were found in astrocytes and even less in vascular endothelial cells. Moreover, significant increases in PINK1 accumulation in the outer membrane of mitochondria and increased Parkin/p62 mitochondrial translocation were shown at 24 h after reperfusion. These findings suggest that the PINK1/Parkin/p62 signalling pathway was involved in the pathophysiological processes following ischemia and reperfusion.

[PMID: 29964088](#)

30. Umbilical Cord-Derived Mesenchymal Stromal Cells Contribute to Neuroprotection in Neonatal Cortical Neurons Damaged by Oxygen-Glucose Deprivation.

Mukai T, Tojo A, Nagamura-Inoue T.

Front Neurol. 2018 Jun 15;9:466. doi: 10.3389/fneur.2018.00466. eCollection 2018.

Several studies have reported that human umbilical cord-derived mesenchymal stromal cells (UC-MSCs) restore neurological damage in vivo through their secretion of paracrine factors. We previously found that UC-MSCs attenuate brain injury by secreting neurotrophic factors, such as brain-derived neurotrophic factor (BDNF) and hepatocyte growth factor (HGF). However, how these factors contribute to neuroprotection remains unknown. In this study, we aimed to investigate to what extent UC-MSC-derived HGF and BDNF contribute to neuroprotection using a Transwell co-culture system of neonatal cortical neurons damaged by oxygen-glucose deprivation. The influence of HGF and BDNF were determined by investigating neurons in both the presence and absence of UC-MSCs as these cells consistently secrete both factors and can be blocked by neutralizing antibodies. In the co-culture, UC-MSCs significantly improved neuronal injury, as indicated by an increase in immature neuron number, neurite outgrowth, and cell proliferation. Co-culture of damaged neurons with UC-MSCs also exhibited a reduction in the number of neurons displaying signs of apoptosis/necrosis. The neuroprotective actions of UC-MSCs were partially reverted by neutralizing antibodies. Together, our findings reveal that UC-MSC-secreted HGF and BDNF have neuroprotective effects on damaged neurons. Further studies should address the existence of other potential neurotrophic paracrine factors.

[PMID: 29963009](#)

31. Pseudobulbar Affect in Survivors of Extreme Prematurity With Cerebellar Injury: Support for the Cerebellar Link in Pathologic Laughter and Crying.

Bodensteiner JB.

Semin Pediatr Neurol. 2018 Jul;26:74-76. doi: 10.1016/j.spen.2017.03.010. Epub 2017 Apr 2.

Pseudobulbar affect, that is, pathologic laughter and crying is being increasingly recognized in adults and is seen in association with a number of diseases like Parkinson disease, dementia, traumatic encephalopathy, and others, but has not previously been described in children with cerebral palsy. The condition pseudobulbar affect may be due to lesions in (or degeneration of) the cerebro-ponto-cerebellar pathways. Here we report 2 children with cerebral palsy who have structural cerebellar injury because of their being born extremely premature who have pathologic crying and probably laughter.

[PMID: 29961526](#)

32. "Cerebral Palsy" in a Patient With Arginase Deficiency.

Jichlinski A, Clarke L, Whitehead MT, Gropman A.

Semin Pediatr Neurol. 2018 Jul;26:110-114. doi: 10.1016/j.spen.2017.03.016. Epub 2017 Apr 1.

Inborn errors of metabolism (IEMs) are thought to present in infancy with acute decompensation including feeding intolerance and vomiting, lethargy, and coma. Most practitioners assume that children will be diagnosed in their first months of life. However, certain IEMs present more insidiously, and occasionally children fail to receive newborn screening resulting in delayed diagnoses, as metabolic and genetic disorders are overlooked causes of cognitive and neurologic deficits. Although signs and symptoms may be present but subtle, careful and detailed history taking, particularly of a child's diet and neurologic medical history, in addition to certain physical examination findings may suggest a diagnosis that is later supported by laboratory and radiographic testing. We present the case of an 11-year-old girl who presented with a diagnosis of cerebral palsy, seizure disorder, and concerns of fatigue and increasing seizure frequency. During hospitalization, she was found to have hyperammonemia, and a diagnosis of arginase deficiency was made. More thorough review of her previous records may have raised suspicion for IEM earlier.

[PMID: 29961498](#)